

What is claimed is:

1. A particle comprising:  
an inorganic matrix comprising channels; and  
5 a composition disposed in said channels, said composition comprising organic structure-directing agent and active agent,  
said particle being capable of controllably releasing said active agent.
- 10 2. The particle of claim 1 further comprising a template comprising said composition.
3. The particle of claim 2 having an x-ray diffraction peak less than 6 degrees two theta using copper  $K_{\alpha}$  radiation.
- 15 4. The particle of claim 1, wherein said inorganic matrix was formed in the presence of said composition.
5. The particle of claim 1, wherein said active agent is hydrophobic.
- 20 6. The particle of claim 1, wherein said active agent is hydrophilic.
7. The particle of claim 1, wherein said active agent comprises pheromone.
- 25 8. The particle of claim 1, wherein said active agent is selected from the group consisting of trans-8, trans-10-dedecadien-1-ol, Z-11-tetradecenyl acetate, E-11-tetradecenyl acetate, Z-8-dodecenyl acetate, E-8 dodecenyl acetate, Z-8-dodecenol, Z,Z-3,13-octadecyldienyl acetate, E,Z-3,13-octadecyldienyl acetate and Z-9-dodecenyl acetate and mixtures thereof.
- 30 9. The particle of claim 1, wherein said active agent comprises a curing agent.

10. The particle of claim 1, wherein said active agent is selected from the group consisting of pharmaceutical agents, therapeutic agents, antimicrobial agents, agricultural agents, hygiene agents, preservatives, disinfectants, and combinations thereof.

5 11. The particle of claim 1, wherein said active agent is selected from the group consisting of chlorhexidine digluconate, silver ion, glycerol monolaurate and combinations thereof.

10 12. The particle of claim 1, wherein said active agent is dissolved in said organic structure-directing agent.

13. The particle of claim 1, wherein said active agent is associated with said organic structure-directing agent.

15 14. The particle of claim 1, wherein said particle has an average particle size of no greater than about 20  $\mu\text{m}$ .

16 15. The particle of claim 1, wherein said particle has an average particle size no greater than about 15  $\mu\text{m}$ .

20 16. The particle of claim 1, wherein said particle has an average particle size no greater than about 1000 nm.

25 17. The particle of claim 1, wherein said particle has an average particle size no greater than about 100 nm.

18. The particle of claim 1, wherein the channels of said particle have an average cross-sectional dimension no greater than about 50 nm.

30 19. The particle of claim 1, wherein the channels of said particle have an average cross-sectional dimension no greater than 30 nm.

20. The particle of claim 1, wherein said organic structure-directing agent comprises surfactant.

21. The particle of claim 1, wherein said organic structure-directing agent comprises latex particles.

22. The particle of claim 1, wherein said channels are in a substantially parallel relationship.

23. The particle of claim 1, wherein said channels form an interconnected network.

24. The particle of claim 1, wherein said inorganic matrix comprises an aggregate of metal oxide particles.

25. The particle of claim 1, wherein said inorganic matrix comprises metal oxide selected from the group consisting of alumina, titania, zirconia and combinations thereof.

26. The particle of claim 1, wherein said inorganic matrix comprises silica.

27. A first composition comprising:  
a plurality of particles comprising  
an inorganic matrix comprising channels; and  
a second composition disposed in said channels, said second composition comprising organic structure-directing agent and active agent,  
said particles being capable of controllably releasing said active agent.

28. The first composition of claim 27, wherein said inorganic matrix was formed in the presence of said second composition.

29. The first composition of claim 27, further comprising a vehicle.

30. The first composition of claim 29, wherein said vehicle is selected from the group consisting of water, alcohols, ketones, aldehydes, nitriles, esters, carboxylates, polyols, hydrocarbons, fluorocarbons and combinations thereof.

31. The first composition of claim 29, wherein said vehicle comprises polymerizable monomers.

32. The first composition of claim 29, wherein said vehicle comprises a polymer selected from the group consisting of thermoplastic polymer, thermoset polymer, elastomer and combinations thereof.

33. The first composition of claim 29, wherein said vehicle comprises epoxy resin and said active agent comprises a curing agent.

34. The first composition of claim 29, wherein said vehicle comprises an adhesive composition.

35. The first composition of claim 27, wherein said organic structure-directing agent comprises surfactant.

36. The first composition of claim 27, wherein said organic structure-directing agent comprises latex particles.

37. The first composition of claim 27, wherein said active agent comprises pheromone.

38. The first composition of claim 27, wherein said active agent is selected from the group consisting of trans-8, trans-10-dodecadien-1-ol, Z-11-tetradecenyl acetate, E-11-tetradecenyl acetate, Z-8-dodecenyl acetate, E-8 dodecenyl acetate, Z-8-dodecenol,

Z,Z-3,13-octadecyldienyl acetate, E,Z-3,13-octadecyldienyl acetate and Z-9-dodecenyl acetate and mixtures thereof.

39. The particle of claim 1, wherein said active agent is selected from the group consisting of pharmaceutical agents, therapeutic agents, antimicrobial agents, agricultural agents, hygiene agents, preservatives, disinfectants, and combinations thereof.

40. The particle of claim 1, wherein said active agent is selected from the group consisting of chlorhexidine digluconate, silver ion, glycerol monolaurate and combinations thereof.

41. The particle of claim 1, wherein said inorganic matrix comprises silica.

42. A powder comprising the first composition of claim 27.

43. A film comprising the first composition of claim 27.

44. An article comprising the first composition of claim 27.

45. The article of claim 44, wherein said article comprises a form selected from the group consisting of a tablet, a pellet and a brick.

46. An article comprising

a) a container; and

b) a plurality of particles comprising

i) an inorganic matrix comprising channels, and

ii) a composition disposed in said channels, said composition

comprising an organic structure-directing agent and active agent,

said particles being capable of controllably releasing said active agent.

47. The article of claim 46, further comprising an aerosol propellant.

48. The article of claim 46, further comprising a vehicle.

49. The article of claim 48, further comprising an aerosol propellant.

50. The article of claim 48, wherein said particles are disposed in said vehicle.

51. The article of claim 48, wherein said vehicle is selected from the group consisting of water, alcohols, ketones, aldehydes, nitriles, esters, carboxylates, polyols, hydrocarbons, fluorocarbons and combinations thereof.

52. The article of claim 48, wherein said active agent is selected from the group consisting of pharmaceutical agents, therapeutic agents, antimicrobial agents, agricultural agents, hygiene agents, preservatives, disinfectants, curing agents, and combinations thereof.

53. The article of claim 48, wherein said active agent comprises pheromone.

54. A method comprising:  
contacting a target with a first composition comprising a plurality of particles, said particles comprising  
i) an inorganic matrix comprising channels, and  
ii) a second composition disposed in said channels, said second composition comprising an organic structure-directing agent and active agent, said particles being capable of controllably releasing said active agent.

55. The method of claim 54, wherein said target comprises soil.

56. The method of claim 54, wherein said target comprises a plant.

57. The method of claim 54, wherein said target comprises a tree.

58. The method of claim 54, further comprising spraying said first composition.

59. The method of claim 54, wherein said first composition further comprises a vehicle.

60. The method of claim 54, wherein said vehicle is selected from the group consisting of water, alcohols, ketones, aldehydes, nitriles, esters, carboxylates, polyols, hydrocarbons, fluorocarbons and combinations thereof.

61. The method of claim 54, wherein said vehicle comprises a polymer selected from the group consisting of thermoplastic polymer, thermoset polymer, elastomer and combinations thereof.

62. The method of claim 54, wherein said active agent comprises a pheromone.

63. The method of claim 54, wherein said active agent is selected from the group consisting of trans-8, trans-10-dedecadien-1-ol, Z-11-tetradecenyl acetate, E-11-tetradecenyl acetate, Z-8-dodecenyl acetate, E-8 dodecenyl acetate, Z-8-dodecenol, Z,Z-3,13-octadecyldienyl acetate, E,Z-3,13-octadecyldienyl acetate and Z-9-dodecenyl acetate and mixtures thereof.

64. The method of claim 54, wherein said active agent is selected from the group consisting of pharmaceutical agents, therapeutic agents, antimicrobial agents, agricultural agents, hygiene agents, preservatives, disinfectants, and combinations thereof.

65. The method of claim 54, wherein said active agent is selected from the group consisting of chlorhexidine digluconate, silver ion, glycerol monolaurate and combinations thereof.

66. The method of claim 54, further comprising exposing said particles to radiation to release said active agent.

67. The method of claim 66, wherein said radiation is selected from the group consisting of thermal radiation, ultraviolet radiation and electron beam radiation.

68. The method of claim 54, wherein said active agent comprises a curing agent.

69. The method of claim 54, wherein said organic structure-directing agent comprises surfactant.

70. The method of claim 54, wherein said organic structure-directing agent comprises latex particles.

71. The method of claim 54, wherein said particles further comprise a template comprising said composition.

72. A method of making particles capable of controllably releasing an active agent, said method comprising  
forming an inorganic matrix in the presence of a composition comprising organic structure-directing agent and active agent.

73. The method of claim 72, wherein forming an inorganic matrix comprises condensing an inorganic component.

74. The method of claim 73, wherein said inorganic component is selected from the group consisting of metal alkoxides, metal carboxylates, metal salts and combinations thereof.

75. The method of claim 73, wherein said inorganic component comprises alkoxy silane.



76. The method of claim 72, wherein said inorganic matrix comprises metal oxide selected from the group consisting of alumina, titania, zirconia and combinations thereof.

5 77. The method of claim 72, wherein said inorganic matrix comprises silica.

78. The method of claim 72, wherein said forming an inorganic matrix comprises condensing an inorganic component in the presence of a template comprising said composition.

10 79. The method of claim 72, wherein said forming an inorganic matrix comprises irreversibly agglomerating colloidal metal oxide particles.

15 80. The method of claim 79, further comprising drying said agglomerated metal oxide particles.

81. The method of claim 72, wherein said organic structure-directing agent comprises surfactant.

20 82. The method of claim 72, wherein said organic structure-directing agent comprises latex particles.

83. The method of claim 72, further comprising forming said inorganic matrix in the presence of a template comprising said composition.

25 84. The method of claim 72, wherein said composition further comprises antioxidant.

30 85. A particle comprising:  
an inorganic matrix comprising channels; and  
a composition disposed in said channels, said composition comprising surfactant and active agent selected from the group consisting of pharmaceutical agents,

therapeutic agents, antimicrobial agents, agricultural agents, curing agents, and combinations thereof

said particle being capable of controllably releasing the active agent.

5           86.    The particle of claim 85, wherein said active agent comprises pheromone.

10           87.    The particle of claim 86, wherein said pheromone is selected from the group consisting of trans-8, trans-10-dodecadien-1-ol, Z-11-tetradecenyl acetate, E-11-tetradecenyl acetate, Z-8-dodecenyl acetate, E-8-dodecenyl acetate, Z-8-dodecenol, Z,Z-3,13-octadecyldienyl acetate, E,Z-3,13-octadecyldienyl acetate and Z-9-dodecenyl acetate and mixtures thereof.

15           88.    The particle of claim 86, wherein said inorganic matrix comprises silica.

          89.    The particle of claim 86, further comprising a template comprising said composition.

20           90.    The particle of claim 89, wherein said inorganic matrix was formed in the presence of said template.

          91.    The particle of claim 86, wherein said pheromone is dissolved in said surfactant.

25           92.    A composition comprising a plurality of particles according to claim 86.

          93.    An article comprising a container, and a plurality of particles according to claim 86 disposed in said container.

30           94.    The article of claim 93, further comprising an aerosol propellant.

          95.    A method comprising contacting a target with a first composition comprising a plurality of the particles of claim 86.

96. The method of claim 95, wherein said target comprises soil.

97. The method of claim 95, wherein said target comprises a plant.

98. The method of claim 95, wherein said target comprises an apple tree.

99. The method of claim 95, further comprising spraying said first composition.

100. The method of claim 95, wherein said first composition further comprises a vehicle.

101. The method of claim 100, wherein said vehicle is selected from the group consisting of water, alcohols, ketones, aldehydes, nitriles, esters, carboxylates, polyols, hydrocarbons, fluorocarbons and combinations thereof.

102. A method of making particles capable of controllably releasing an active agent, said method comprising drying a composition comprising an inorganic component, organic structure-directing agent and active agent.

103. The method of claim 102, further comprising spraying said composition on a substrate prior to drying said composition.

104. The method of claim 102, wherein said composition has a pH of from 4 to 9.

105. A method of treating a target comprising:

- a. contacting the target with a composition comprising an inorganic component, organic structure-directing agent and active agent; and
- b. drying said composition to form particles capable of controllably releasing said active agent.

106. The method of claim 105, wherein said composition has a pH of from 4 to 9.

5 107. The method of claim 105, further comprising spraying said composition.

108. A method of making particles capable of controllably releasing active agent, said method comprising forming an inorganic matrix in the presence of a composition having a pH of from 4 to 9, said composition comprising an inorganic component, organic structure-directing agent and the active agent.